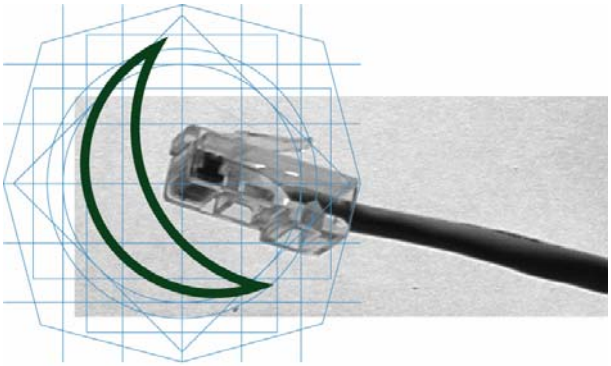
Highlight for CNS-0520081

Award No:
0520081

Project Title:
Collaborative Research (NeTS-NBD):
Increasing the Energy Efficiency of the Internet with a Focus on Edge Devices

Investigators:
Ken Christensen (USF)
Alan George (UF)

Institution:
University of South Florida
University of Florida



Website:

http://www.csee.usf.edu/~christen/energy/main.html

Description of Graphic Image:
This is an image representative of our project. The image uses the IEEE 1621 symbol for low-power sleep and an Ethernet connector, and summarizes our goal of reducing the energy used by Ethernet networks. The graphic is from Bruce Nordman at LBNL (full permission for unlimited use is granted).

Project Description and Outcome:

NSF-funded researchers at the University of South Florida and the University of Florida are investigating new methods to reduce the energy consumption of the Internet by focusing on the primary and often neglected energy consumer, edge devices including desktop PCs and set-top boxes. Their work is a pioneering look at reducing the energy wasted by idle network links and networked edge devices that typically remain fully powered-up during frequent and often lengthy periods of idleness. Estimates of the potential savings from the research outcomes are in the 10's to 100's of millions of dollars per year in the US alone. The research objectives, as set by the principal investigators Dr. Christensen and Dr. George, are to explore and disseminate new ideas in 1) matching the data rate (or speed) of network links to the amount of data transported on the links and 2) using small, low-power microcontroller processors to proxy for larger processors when the full capabilities of the larger processors are not needed for maintaining network connectivity. To achieve research impact, a key goal of this project is to work with the energy efficiency community, government agencies, companies that design and manufacture networking equipment, and the standards bodies that set the direction for how networking equipment will operate.

At the mid-point in this three-year project, the primary contribution has been proposing, defining, and analyzing an Adaptive Link Rate method for Ethernet. Ethernet is the most widely used wired networking technology with over one billion connections world-wide. A direct result of this work has been the formal creation of an Energy Efficient Ethernet study group within the IEEE 802.3 standards working group. The Adaptive Link Rate method was developed in partnership

with Bruce Nordman at Lawrence Berkeley National Laboratory. The Energy Efficient Ethernet study group is being chaired by Mike Bennett, also from Lawrence Berkeley National Laboratory. Participants in the study group come from major network equipment companies including Cisco, Intel, Broadcom, Ericsson, nVidia, and others. This project has also had influence on future EPA Energy Star specifications, which specify that future PCs with network connections must support a capability similar to Adaptive Link Rate.

This NSF-funded project is well on its way to defining global leadership in energy efficiency of computer networks. Numerous invited talks have been given and published work has been well received by other researchers, standards groups, and network equipment companies.

Please select the Primary Strategic Outcome Goal that BEST DESCRIBES the highlight:

☒ Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential and establishing the nation as a global leader in fundamental transformational science and engineering.

☐ Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

☐ Research Infrastructure: Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyber-infrastructure and experimental tools.

Secondary Strategic Outcome Goals that BEST DESCRIBES the highlight:

☐ Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential and establishing the nation as a global leader in fundamental transformational science and engineering.

☒ Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

☐ Research Infrastructure: Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyber-infrastructure and experimental tools.

This work is notable because:

This project has tremendous potential for impact in the short and long term. **It is expected that the results from this project will directly or indirectly lead to energy savings in the 10s to 100s of millions of dollars per year in the US alone that would not otherwise have been achieved.** The path to achieving this goal is through partnerships with the energy efficiency and networking communities, and involvement with standards bodies and network equipment vendors. In the long-term, this project is adding another design objective to the future Internet (FIND) – an energy efficiency design objective that would otherwise not have been considered.

Does this Highlight Represent Transformative or Multidisciplinary Research?

The research is multidisciplinary in that it crosses over between the networking and energy communities. This project is in partnership with Bruce Nordman in the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory.

An additional image related to this project is the "Energy Efficient Ethernet" logo being used by the IEEE 802.3 Energy Efficient Study group. The logo was originally created in fall 2006 by Glen Kramer of Teknovus, Inc. Full permission for unlimited use has been granted by Glen Kramer.